JAPANESE [JP,2000-183680,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
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CLAIMS

[Claim(s)]
[Claim 1] It has a conductor pattern containing at least one crossover finger type-conversion machine and an external connection pad electrically connected to this crossover finger type-conversion machine on a piezo-electric substrate. Said external connection pad carries out the laminating of the two-layer metal layer at least, and it sets in said conductor pattern. At least one resistor which connects electrically the fields which are not connected in direct current exists. Said resistor At least one conductor, Surface acoustic wave equipment which consists of metals as one of the metal layers contained in said external connection pad with said same conductor including at least one metallic-oxide layer which touches this conductor.
[Claim 2] Surface acoustic wave equipment of claim 1 which consists of metals with which said conductor is connected with the 2nd conductor through a metallic-oxide layer into said resistor, and said 2nd conductor is the same as one of the metal layers contained in said external connection pad with metals, and differs from said conductor.
[Claim 3] Surface acoustic wave equipment of claims 1 or 2 to which all of the fields which are not connected in direct current into said conductor pattern are electrically connected by said resistor.
[Claim 4] One surface acoustic wave equipment of claims 1-3 in a range whose resistance of said resistor is 100ohms - 100 M omega.
[Claim 5] One surface acoustic wave equipment of claims 1-4 with which a part of periphery configuration at least] of the contact surface of the metals which contact through said metallic-oxide layer contains at least one sort of tooth form of a comb, the polygonal line, and a curve.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to surface acoustic wave equipment.
[0002]
[Description of the Prior Art] It is carried by mobile communication equipment, such as a portable telephone, as one feature that it is a small light weight, and surface acoustic wave equipment is contributing it to lightweight-ization of a device.
[0003] Surface acoustic wave equipment is the structure which held the surface acoustic element in the package. On a piezo-electric substrate, a surface acoustic element prepares the tandem-type electrode of a pair with which each consists of a bus bar which connects detailed electrode **** and these detailed so that a mutual electrode finger may cross, it forms a crossover finger type-conversion machine, and forms a reflector electrode near the crossover finger type-conversion machine further. The function as a filter is realized by impressing an electrical signal to one tandem-type electrode by making it function as an excitation electrode, and operating the tandem-type electrode of another side as a received electrode. The passband property and out-of-band oppression property in that case are determined by the configuration of electrode ****, and arrangement.
[0004] The signal-processing frequency put in practical use in surface acoustic wave equipment is over 1GHz from hundreds of MHz by implementation of detailed electrode structure. With the surface acoustic wave equipment applied to such a RF field, since the distance between electrode fingers becomes extremely small with several micrometers or less, there is a danger that an electrode finger will cause discharge breakdown with the voltage built between electrode fingers.
[0005] the electromagnetism from the voltage produced by the abrupt change of that operating condition after being carried, when carried in the voltage and the portable telephone which are produced as a cause of this discharge breakdown by the pyroelectricity which a piezo-electric substrate has at the time of surface acoustic wave equipment production, for example, and the outside -- the voltage produced by the noise is mentioned. When an example is given, in being surface acoustic wave equipment with which signal-processing frequency exceeds 2GHz and being the lithium tantalate with which a piezo-electric substrate is usually used, the line breadth and the electrode finger gap of an electrode finger are set to about 0.5 micrometers, respectively. Even when the potential difference of only 5 V occurs between this electrode finger, that field strength is set to mm in about 10kV /, and serves as a value exceeding the breakdown voltage in the inside of air. If discharge breakdown arises, an electrode finger will be destroyed and the property of surface acoustic wave equipment will deteriorate remarkably.
[0006] Moreover, since the heat capacity becomes small so that it becomes small although, as for surface acoustic wave equipment, the miniaturization is progressing quickly, equipment becomes easy to be influenced of the temperature change of the perimeter. For this reason, the effect of the pyroelectricity of a piezo-electric substrate becomes large, and reliability reservation becomes difficult. Since the temperature of an element tends to rise a miniaturization by making face down connection especially of the surface acoustic element with the structure which is present in drawing, it increases to other packaging methods and discharge preventive measures are important.
[0007] The next example is known by the attempt which prevents discharge breakdown of the electrode in surface acoustic wave equipment.
[0008] After producing a resistance link pattern on a piezo-electric substrate beforehand, the method of preventing damage on the electrode pattern of the surface acoustic wave convolver on a piezo-electric substrate with pyroelectricity is shown in JP,5-59609,B by forming a surface acoustic wave equipment pattern. The resistance of the above-mentioned resistance link in this official report sets a lower limit to 1kohm which does not influence a property electrically, and is setting it to 1012 ohms which can miss the charge according a upper limit to pyroelectricity. It is the same metal as an electrode pattern, and, naturally forming in the same thickness comes out of a resistance link to this official report, and it has the publication of a certain purport. However, if it is going to acquire the high resistance described above by the electrode pattern, this quality of the material, and the same thickness, it is necessary to lengthen the overall length of a resistance link or to narrow width of face of a resistance link. Although there is no publication of the purport applied to the surface acoustic wave equipment for RFs (for example, a surface acoustic wave filter, a surface acoustic wave resonator) in this official report, when it applies to such surface acoustic wave equipment, a resistance link becomes remarkably long to the whole equipment, and a resistance link becomes very thin and it becomes easy to become the hindrance of a miniaturization or to disconnect.
[0009] Moreover, in the sound surface wave filter, the method of connecting the both ends of IDT by high

resistance, and easing a charge is indicated by JP,7-303024,A using the resistance of the reflector finger of a resonator. However, if it is the resistivity 2.75x10-8 of an aluminum electrode [omega-m], the electrode digit of 1 micrometer, and 200nm of electrode layer thickness when it is going to produce high resistance at a photolithography production process to an electrode finger and coincidence, 72mm is required in this method, as an overall length to obtain resistance 10kohm. If this high resistance is turned up and formed within a surface acoustic element, 2 will be needed 0.15mm as a formation area, and it will become the hindrance of a miniaturization. Moreover, in this way, with one long electrode finger, we are anxious also about the open circuit under production, and it becomes the factor of a yield fall.

[0010] In addition, the means which is going to absorb the charge generated in a piezo-electric substrate by the package side is indicated by for example, the patent No. 2673993 official report. The structure of preventing discharge breakdown of an electrode is indicated by by connecting an input pad and/or an output pad, and a touch-down pad to this official report by the high resistance pattern. However, since the high resistance pattern indicated by this official report consists of materials of conductivity lower than the metal which constitutes a pad, it needs to form a high resistance pattern independently with other conductor patterns, and causes the fall of productivity. Moreover, in this official report, since the cure against discharge breakdown is performed to a package side, the packaging method will be limited. Moreover, since there is no concrete publication about the specific resistance of a high resistance pattern component in this official report, when a high resistance pattern is miniaturized according to the miniaturization of an element, it is unknown in whether required resistance is acquired.

[0011]

[Problem(s) to be Solved by the Invention] The purpose of this invention is facing preventing discharge breakdown of a crossover finger type-conversion machine, and suppressing the fall of productivity, and preventing enlargement of equipment in surface acoustic wave equipment, especially the surface acoustic wave equipment of face down connection structure.

[0012]

[Means for Solving the Problem] The above-mentioned purpose is attained by this invention of following the (1) - (5).

(1) It has a conductor pattern containing at least one crossover finger type-conversion machine and an external connection pad electrically connected to this crossover finger type-conversion machine on a piezo-electric substrate. Said external connection pad carries out the laminating of the two-layer metal layer at least, and it sets in said conductor pattern. At least one resistor which connects electrically the fields which are not connected in direct current exists. Said resistor At least one conductor, Surface acoustic wave equipment which consists of metals as one of the metal layers contained in said external connection pad with said same conductor including at least one metallic-oxide layer which touches this conductor.

(2) Surface acoustic wave equipment of the above (1) which consists of metals with which said conductor is connected with the 2nd conductor through a metallic-oxide layer into said resistor, and said 2nd conductor is the same as one of the metal layers contained in said external connection pad with metals, and differs from said conductor.

(3) The above (1) or (2) surface acoustic wave equipment to which all of the fields which are not connected in direct current into said conductor pattern are electrically connected by said resistor.

(4) One surface acoustic wave equipment of above-mentioned (1) - (3) in a range whose resistance of said resistor is 100ohms - 100 M omega.

(5) One surface acoustic wave equipment of above-mentioned (1) - (4) with which a part of periphery configuration [at least] of the contact surface of the metals which contact through said metallic-oxide layer contains at least one sort of tooth form of a comb, the polygonal line, and a curve.

[0013]

[Embodiment of the Invention] This invention includes from the configuration I explained below to the configuration III.

[0014] The plan of the example of a configuration of a surface acoustic element used for the surface acoustic wave equipment of Configuration I is shown in configuration I drawing 1 (a), and a part of B-B cross section of drawing 1 (a) is shown in it at drawing 1 (b).

[0015] This surface acoustic element prepares the conductor pattern containing surface acoustic wave resonator 2A which has the crossover finger type-conversion machine inserted with the reflector electrode of a pair, 2B, 2C, 2D, 2E, and the external connection pads 3A and 3B, 3D and 3E on the piezo-electric substrate 1.

[0016] The external connection pads 3A and 3E are I/O pads for connecting with the input/output terminal of surface acoustic wave equipment electrically, and external connection pad 3B and 3D are the touch-down pads for connecting electrically at the touch-down potential of surface acoustic wave equipment. In order to consider as surface acoustic wave equipment, this surface acoustic element is held in a package (not shown), and the hermetic seal of the lid is carried out and carried out. In case this surface acoustic element corresponds to face down connection structure and is held in a package, it makes an external connection pad forming face counter a package, and connects electrically an external connection pad and the conductor pattern by the side of a package through an electric conduction bump.

[0017] As shown in the equal circuit of drawing 6 , it connects with the ladder mold, and the surface acoustic wave resonators 2A-2E function as a surface acoustic wave filter. The outline of each impedance characteristic of each surface acoustic wave resonator is shown in drawing 7 .

[0018] In this invention, a two-layer metal layer considers an external connection pad as the configuration

by which the laminating was carried out at least. For example, external connection pad 3B shown in drawing 1 (b) carries out the laminating of the 1st metal layer 31, the 2nd metal layer 32, and the 3rd metal layer 33 in this order, and is a configuration with other same external connection pads. The reason for making an external connection pad into such a laminated structure is for securing the electrical installation stabilized t the package. Both will become the same thickness if a crossover finger type-conversion machine and an external connection pad are formed in coincidence using the usual photolithography method. However, in the surface acoustic wave resonator used in a RF field, since the thickness of a crossover finger type-conversion machine becomes very thin, thickness sufficient as an external connection pad with the necessity of joining Au ball etc. and forming an electric conduction bump is not obtained. Therefore, the laminating of the 2nd metal layer 32 and the 3rd metal layer 33 is carried out for piling on the 1st metal layer 31 formed in a crossover finger type-conversion machine and coincidence.

[0019] It is for stopping the damage by the electric conduction bump, as for the 2nd metal layer 32, it is desirable to constitute from a high metal of a mechanical strength, for example, the metal containing at least one sort of Cr, Ti, Si, and W, and it is desirable to constitute from a metal containing especially Cr or this.

[0020] Since the 3rd metal layer 33 is formed in order to raise cementation nature with an electric conduction bump, it is desirable to constitute from a metal with such an effect, for example, the metal containing at least one sort of aluminum, Au, and nickel, and it is desirable to constitute from a metal containing especially aluminum or this.

[0021] In addition, let the metal in this specification be a concept containing others, an alloy, and an intermetallic compound. [simple substance / metal]

[0022] In this invention, at least one resistor which connects electrically the fields insulated like a direct current in a conductor pattern is prepared in the surface acoustic element which has the external connection pad by which piling was carried out in this way. This resistor contains at least one conductor and at least one metallic-oxide layer which touches this conductor. And said conductor consists of same metals as one of the metal layers contained in said external connection pad.

[0023] For example, the element shown in drawing 1 (a) has two resistors 4. One resistor 4 has connected electrically the Kushigata electrodes of the pair contained in surface acoustic wave resonator 2B through the resonator connection pattern 21, and the resistor 4 of another side has connected electrically the Kushigata electrodes of the pair contained in surface acoustic wave resonator 2D through the resonator connection pattern 22. Moreover, by preparing both resistors, the resonator connection patterns 21 and 22 will be electrically connected to an external connection pad, and the field which floated electrically into the conductor pattern is lost.

[0024] Drawing 1 (b) explains the configuration of a resistor 4 shown in drawing 1 (a). This resistor 4 has the 2nd metal layer 32 formed in coincidence as said conductor, when external connection pad 3B is formed, adjoins the both sides of this conductor and has the metallic-oxide layer 5 formed by that scaling after 1st metal layer 31 formation.

[0025] In case the element to illustrate is manufactured, after forming the 1st metal layer 31, each pattern of a surface acoustic wave resonator, a resonator connection pattern, and the external connection pad lowest layer is first formed according to a photolithography process. Subsequently, near the 1st metal layer 31 surface is oxidized, and the metallic-oxide layer 5 is formed. Subsequently, the 2nd metal layer 32 is formed and each pattern of an external connection pad interlayer and said conductor is formed according to a photolithography process. Subsequently, the 3rd metal layer 33 is formed and the pattern of the external connection pad maximum upper layer is formed according to a photolithography process. In addition, in drawing 1 (b), said conductor in a resistor 4 may consist of 3rd metal layers 33.

[0026] Thus, the following effects are realized, in order to use the conductor which consists of same metals as one of the metal layers contained in an external connection pad as a part of resistor 4 and to use the metallic-oxide layer 5 as a part of resistor 4. That is, on the occasion of formation of said conductor, what is necessary is just to change a mask pattern in the photolithography production process in the case of external connection pad formation, and it is not necessary to establish a new production process. Therefore, a cost rise and a productivity slowdown are not caused substantially. The resistance needed for a resistor 4 on the other hand must be high to the degree which does not affect the property of surface acoustic wave equipment, and must be low to the degree which can miss the pyroelectric load of the piezo-electric substrate in the operating condition assumed. Specifically, it is desirable to make resistance into within the limits of 100ohms - 100 M omega. However, since huge-izing and/or narrow-width-izing of a resistor are needed in order to acquire such resistance when a resistor is constituted only from a metal, neither enlargement of an element nor open-circuit generating of a resistor is avoided. on the other hand -- since the high metallic-oxide layer 5 of specific resistance is made to exist in a resistor 4 in this invention -- a resistor -- enlargement -- and it is not necessary to make it narrow-width, and it is small and a reliable element is realized.

[0027] Although it can also form by film-izing a metallic oxide by vapor growth etc., since a thin and homogeneous layer's being formed and productivity become good, as for the metallic-oxide layer 5, it is desirable to form by oxidation near the 1st metal layer 31 surface. What is necessary is just to leave it in the oxidizing atmosphere of the air middle class, there being no ordinary temperature and specifically heating, after forming the 1st metal layer 31.

[0028] As a metal which can form a thin and homogeneous oxide layer in the surface into an oxidizing atmosphere For example, aluminum, Ti, Cr, Si, Sc, Cu, Mg, nickel, W, Zr, The metal containing at least one sort chosen from Mn, Mo, Fe, Ta, Co, Zn, V, and Cd is mentioned, and the metal containing at least one sort chosen from aluminum, Ti, Cr, Si, Sc, Cu, Mg, nickel, and W is desirable among these. In addition, since the

example of illustration constitutes a crossover finger type-conversion machine from the 1st metal layer 31 which is a candidate for oxidation, as for the 1st metal layer 31, it is desirable to constitute from a metal suitable for a crossover finger type-conversion machine and a metal which specifically contains aluminum at least.

[0029] The metallic-oxide layer 5 is governing the resistance of a resistor 4 substantially. That is, the specific resistance of the metallic-oxide layer 5 and thickness, and the area of the contact surface of the metals which contact through the metallic-oxide layer 5 are governing the resistance of a resistor 4. Therefore, what is necessary is just to determine thickness and a touch area suitably according to specific resistance so that it can do with the value of a request of the resistance of a resistor. What is necessary is just to specifically make a touch area about [40-4000 micrometers] into two that what is necessary is just to set thickness to about 3-5nm, when it constitutes the metallic-oxide layer 5 from an aluminum oxide.

[0030] By the way, this invention persons found out that the resistance by said metallic-oxide layer varied to some extent depending on production conditions, while making many samples as an experiment. Moreover, since thickness was the thin film which is several nanometers, when the direct current voltage of several volts was impressed, it also found said metallic-oxide layer that whether it becomes a short circuit or it becomes disconnection may change with service conditions. In order to obtain the resistor of the property which solved these problems and was stabilized, it is desirable to carry out two-layer mediation of the metallic-oxide layer at least into a resistor in this invention.

[0031] For example, in drawing 1 (b), if patterning is carried out so that an opening may not be prepared between the 2nd metal layer 32 of external connection pad 3B, and the 2nd metal layer 32 of a resistor 4, it will become the configuration that only one metallic-oxide layer 5 exists in a resistor 4. Though dispersion was shown without stabilizing the resistance of the metallic-oxide layer 5 when it considered as this configuration, this invention persons checked that resistance dispersion of a resistor 4 could be controlled if the metallic-oxide layer 5 is connected to a two-step serial as shown in drawing 1 (b). Moreover, this invention persons also checked that pressure-proofing of a resistor improved in proportion [almost] to the number of stages of a metallic-oxide layer to coincidence. Therefore, it is effective in raising the precision o resistance and raising pressure-proofing to connect said metallic-oxide layer to serial multistage into a resistor.

[0032] The plan shown in drawing 8 expands and shows the connection of the external connection pad 3B and the resistor 4 which are shown in drawing 1 (a). In external connection pad 3B shown in drawing 8 , the metallic-oxide layer 5 exists in the surface of the 1st metal layer, and the 2nd metal layer 32 of a resistor edge touches this metallic-oxide layer 5. In drawing 8 , the configuration of the contact surface of the metals through the metallic-oxide layer 5 has become rectangle-like. Although only a touch area may be changed maintaining a contact surface configuration at a rectangle in case the area of the contact surface is changed, in order to control resistance, a touch area may be changed by configuration modification of the contact surface. For example, in the example shown in drawing 9 , drawing 10 , and drawing 11 , a part of periphery configuration [at least] of the contact surface is a thing containing the tooth form, the polygonal line, or the curve of a comb, and, in all, the touch area is small compared with drawing 8 .

[0033] Moreover, high resistance can be acquired, without dropping bonding strength on contact of the metals through the metallic-oxide layer 5, without changing a touch area, if a contact surface configuration is set up so that it may have the field where width of face is narrow since specific resistance tends to become high near the rim of the metallic-oxide layer 5 in the contact surface. Therefore, the example of drawing 9 which has the contact surface with the field where width of face is narrow, drawing 10 , and drawing 11 is desirable also from this point.

[0034] Although it is necessary to pierce through the metallic-oxide layer 5 in external connection pad 3B and current needs to pass by drawing 1 (b), as described above, it is very thin, and an external connection pad is hundreds of micrometer angle, and since the track cross section is large, the metallic-oxide layer 5 does not have a bad influence on the property as surface acoustic wave equipment. Moreover, in the example of illustration, in order to oxidize the whole surface of the 1st metal layer 31, a metallic-oxide layer will exist in the surface of a surface acoustic wave resonator, and this does not influence a property substantially, either. However, it is good also as a configuration which carries out the mask of a part of 1st metal layer 31, performs oxidation treatment if needed, and forms a metallic-oxide layer only in a required field.

[0035] It consists of metals which the surface acoustic wave equipment of the configuration II configuration II is the same as one of the metal layers by which said conductor is connected with the 2nd conductor through the metallic-oxide layer into said resistor, and said 2nd conductor is contained in said external connection pad, and are different from said conductor.

[0036] The plan of the example of a configuration of a surface acoustic element used for the surface acoustic wave equipment of Configuration II is shown in drawing 2 (a), and a part of B-B cross section of drawing 2 (a) is shown in it at drawing 2 (b). About the portion except a resistor 4, since the element shown in drawing 2 (a) and drawing 2 (b) is the same as that of drawing 1 (a) and drawing 1 (b) respectively, it explains only a resistor 4.

[0037] The resistor 4 which shows a cross section uses the conductor (the 2nd metal layer 32) of drawing 1 (b) as two division patterns, and makes the 1st metal layer 31 placed between drawing 2 (b) as said 2nd conductor between them. This 2nd conductor is formed in the 1st metal layer 31 and coincidence which constitute the 1st metal layer 31 and the resonator connection pattern 21 in external connection pad 3B, and the metallic-oxide layer 5 as well as other 1st metal layers 31 is formed in that surface. That is, this resistor 4 is the configuration of having connected four metallic-oxide layers 5 to the multistage serial. Thus

in the example of a configuration shown in drawing 2 (a) and drawing 2 (b), since it can increase rather than the example of a configuration which shows the number of the metallic-oxide layers 5 in a resistor 4 to drawing 1 (a) and drawing 1 (b), resistance dispersion of a resistor 4 and pressure-proofing are more improvable.

[0038] In case the element to illustrate is manufactured, after forming the 1st metal layer 31, each pattern of a surface acoustic wave resonator, a resonator connection pattern, the external connection pad lowest layer, and said 2nd conductor is first formed according to a photolithography process. Subsequently, near the 1st metal layer 31 surface is oxidized, and the metallic-oxide layer 5 is formed. Subsequently, the 2nd metal layer 32 is formed and each pattern of an external connection pad interlayer and said conductor is formed according to a photolithography process. Subsequently, the 3rd metal layer 33 is formed and the pattern of the external connection pad maximum upper layer is formed according to a photolithography process.

[0039] The plan of other examples of a configuration of a surface acoustic element used for the surface acoustic wave equipment of Configuration II is shown in drawing 3 (a), and a part of B-B cross section of drawing 3 (a) is shown in it at drawing 3 (b).

[0040] This element is the same as the element which each pattern of a surface acoustic wave resonator and the resonator connection pattern 21 was constituted from a 3rd metal layer 33, and also is shown in drawing 2 (a) and drawing 2 (b). Also in this element, since it can increase rather than the example of a configuration which shows the number of the metallic-oxide layers 5 in a resistor 4 to drawing 1 (a) and drawing 1 (b), resistance dispersion of a resistor 4 and pressure-proofing are more improvable.

[0041] This element is produced in the following procedures. First, after forming the 1st metal layer 31, each pattern of the external connection pad lowest layer and said 2nd conductor is formed according to a photolithography process. Subsequently, near the 1st metal layer 31 surface is oxidized, and the metallic-oxide layer 5 is formed. Subsequently, the 2nd metal layer 32 is formed and each pattern of an external connection pad interlayer and said conductor is formed according to a photolithography process. Subsequently, the 3rd metal layer 33 is formed and each pattern of the surface acoustic wave resonator, resonator connection pattern, and external connection pad maximum upper layer is formed according to a photolithography process.

[0042] In addition, in drawing 2 (b) and drawing 3 (b), the 2nd metal layer 32 of one side [at least one side of a conductor], one [i.e., / at least], in a resistor 4 may consist of 3rd metal layers 33. In that case, a conductor will be formed in the external connection pad 3B maximum upper layer and coincidence. Even in such a case, since the number of the metallic-oxide layers 5 in a resistor 4 does not change, the same effect is realized.

[0043] The configuration of the contact surface which minded the metallic-oxide layer 5 of a conductor and the 2nd conductor in the resistor 4 of Configuration II is controllable to be shown in drawing 9 , drawing 10 , and drawing 11 , respectively.

[0044] All of the fields by which the surface acoustic wave equipment of the configuration III configuration II is not connected in direct current into said conductor pattern containing a crossover finger type-conversion machine and an external connection pad are connected electrically.

[0045] The plan of the example of a configuration of a surface acoustic element used for the surface acoustic wave equipment of Configuration III is shown in drawing 4 (a), and a part of B-B cross section of drawing 4 (a) is shown in it at drawing 4 (b). About the portion except a resistor 4, since the element shown in drawing 4 (a) and drawing 4 (b) is the same as that of drawing 1 (a) and drawing 1 (b) respectively, it explains only a resistor 4.

[0046] In the element to illustrate, a resistor 4 consists of a resistor bar 41 and a metal frame 42. The metal frame 42 is formed near the rim of the piezo-electric substrate 1 surface so that the conductor pattern containing a crossover finger type-conversion machine and an external connection pad may be surrounded. On the other hand, the resistor bars 41 are Configuration I and the same configuration as the resistor 4 of Configuration II. The metal frame 42 consists of 1st metal layers 31, as shown in drawing 4 (b), it is formed in other conductor patterns and coincidence, and has the metallic-oxide layer 5 on the surface. In addition, the metal frame 42 can also be formed in the 2nd metal layer 32 or the 3rd metal layer 33, and coincidence.

[0047] With this element, all of the fields which are not connected like a direct current in said conductor pattern are connected by the resistor 4. Since all the pyroelectric loads generated on the surface acoustic element surface by this configuration then heating, and cooling are enabled to move between said fields and equalization of the charge on the whole surface of an element can be attained, the potential difference does not become large between specific fields. Therefore, the effect which prevents discharge breakdown between the fields which are not connected in direct current improves remarkably. Moreover, since each resistor bar 41 is connected through the metal frame 42, it becomes easy to set up the number of the metallic-oxide layers 5 the optimal in each resistor bar 41, and the flexibility of layout is high.

[0048] As another example of a configuration of Configuration III, the surface acoustic element in a multiplex-mode mold surface acoustic wave filter is shown in drawing 5 . This surface acoustic element is the same about having connected mutually all the fields that are not connected in direct current into the conductor pattern by high resistance by the resistor, although the principles of operation differ to the element of drawing 4 (a) and the points which form four resistor bars 41 and are surrounding the conductor pattern instead of the metal frame 42 in drawing 4 (a) differ. Thus, it faces applying this invention and especially the use of a surface acoustic element is not limited.

[0049] In order to check the one example effect of the invention of an experiment, the surface acoustic wave equipment sample which has the element of a configuration of being shown in drawing 2 (a) and

drawing 2 (b) was actually produced, and the following experiments were conducted. The produced sample is a 2.5-step ladder mold surface acoustic wave filter, and is 90MHz in 1842.5 MHz center frequency and pass band width. The surface acoustic element was carried in the base board made from a ceramic of three angles. And an electric flow is taken between a package and a surface acoustic element, and it enabled it to measure electrical characteristics from a package by face down connection mentioned above.
[0050] When producing this element, aluminum layer with a thickness of 210nm was first formed as the 1st metal layer 31 on the piezo-electric substrate 1 which consists of 36-degree rotation Y cut lithium tantalate. Patterning of this aluminum layer was carried out, and each pattern of a surface acoustic wave resonator, a resonator connection pattern, and the external connection pad lowest layer was formed. Subsequently, into air, it heated at 150 degrees C for 1 hour, and the metallic-oxide layer 5 was formed. When the thickness of this metallic-oxide layer was measured, it was about 5nm. Next, patterning of the Cr layer with a thickness of 50nm was formed and carried out as the 2nd metal layer 32, and each pattern of an external connection pad interlayer and said conductor was formed. Subsequently, aluminum layer with a thickness of 1000nm was formed as the 3rd metal layer 33, and the pattern of the external connection pad maximum upper layer was formed.
[0051] Moreover, a resistor 4 was not formed, and also the element was produced like drawing 2 (a) and drawing 2 (b), this element was carried in the package, and it considered as the comparison sample.
[0052] Although measured value varied about **50% when the resistance of a resistor 4 was measured about 25 this invention samples, the average was about 200komega. On the other hand, when the resistance between the resonator connection pattern 21 and 22 was measured in the comparison sample, it was a value (100 M omega or more) exceeding a measurement limit.
[0053] Next, after soldering these samples to the printed circuit board for measurement with 50-ohm system impedance, the reliability trial which between hot environments (260 degrees C) and ordinary temperature environment (about 20 degrees C) is made to shift in transition-time 5 seconds, and holds it for 5 minutes, respectively was performed, it connected with the measuring circuit said whole printed circuit board before and after the trial, and the frequency characteristic of each sample was measured with the network analyzer. In addition, the count of shift to hot environments was made into 5 times. Although the environmental condition usually used is exceeded, the conditions of this trial were carried out in order to check the effect of this invention.
[0054] Although each sample set to 25 the number with which the trial was presented, with the comparison sample which did not prepare a resistor, the property had deteriorated sharply in all 25 pieces. As a result of decomposing a comparison sample and performing internal observation, discharge breakdown had arisen among both the electrode fingers (mutual distance of about 0.5 micrometers) of a surface acoustic wave resonator. On the other hand, although five things from which several MHz filter bandwidth changed were accepted with this invention sample which prepared the resistor, abnormalities were not accepted in other things. In what abnormalities were accepted in, discharge breakdown was accepted in the same part as a comparison sample.
[0055] The above result shows that the property deterioration by the strong thermal shock was controlled with this invention sample.
[0056] The number of the metallic-oxide layers 5 in example of experiment 2 resistor 4 was set to 25, and also the sample was produced like the example 1 of an experiment. However, by adjusting the touch area through the metallic-oxide layer 5, the resistance of a resistor 4 was designed so that it might become the same as that of the resistor 4 of the example 1 of an experiment.
[0057] When the resistance of a resistor 4 was measured about these 25 samples, dispersion in resistance was about **20%. And as a result of performing a reliability trial like the example 1 of an experiment, only two pieces only showed property deterioration slightly among 25 pieces. That is, it was checked that it is effective in the improvement in reliability by stabilization of resistance to increase the connection number of stages of the metallic-oxide layer 5.
[0058] Moreover, when the comparison with the sample of the example 1 of an experiment was performed about pressure-proofing of a resistor 4, in the sample of the example 1 of an experiment, it was an average of 68V in the thing of the example 2 of an experiment to pressure-proofing of a resistor 4 having been an average of 5V. That is, it was checked by increasing the connection number of stages of the metallic-oxide layer 5 that resistance can be adjusted easily and that pressure-proofing improves and reliability improves sharply.
[0059] The sample of a configuration of being shown in example of experiment 3 drawing 4 (a) and drawing 4 (b) was produced by the method according to the example 1 of an experiment. However, the number of the metallic-oxide layers 5 in a resistor 4 was set to 25. Moreover, by adjusting the touch area through the metallic-oxide layer 5, the resistance of ten resistor bars 41 in drawing was designed so that it might become the same as that of the resistor 4 of the example 1 of an experiment.
[0060] As a result of performing a reliability trial like the example 1 of an experiment about this sample, property deterioration was not accepted at all. This result shows that the reliability of an element improves sharply by Configuration III.
[0061] The configuration of the 2nd metal layer 32 of contacting the 1st metal layer 31 through the metallic-oxide layer 5 into the resistor 4 of example of experiment 4 drawing 2 (b) was used as the tooth form of a comb as shown in drawing 9 , and also the sample was produced like the example 1 of an experiment. The resistance on layout of this resistor 4 was set to the same 200kohm as the example 1 of an experiment by adjusting the area of the contact surface through the metallic-oxide layer 5 of the 1st metal layer 31 and the 2nd metal layer 32. However, when the resistance of a resistor 4 was surveyed, it was set

to abbreviation 400kohm by the average of 25 pieces. By controlling the configuration of the contact surface which minded the metallic-oxide layer in the resistor from this result shows that resistance can be adjusted delicately. Therefore, the electrical property of a surface acoustic wave filter and the resistance of a resistor can be optimized by controlling the configuration of said contact surface.
[0062]
[Effect of the Invention] In this invention, discharge breakdown of a crossover finger type-conversion machine can be prevented in surface acoustic wave equipment, especially the surface acoustic wave equipment of face down connection structure, without causing the fall of productivity, and enlargement of equipment.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) is the plan of the surface acoustic element concerning the configuration I of this invention, and (b) is the B-B cross section of (a).
[Drawing 2] (a) is the plan of the surface acoustic element concerning the configuration II of this invention, and (b) is the B-B cross section of (a).
[Drawing 3] (a) is the plan of the surface acoustic element concerning the configuration II of this invention, and (b) is the B-B cross section of (a).
[Drawing 4] (a) is the plan of the surface acoustic element concerning the configuration III of this invention, and (b) is the B-B cross section of (a).
[Drawing 5] It is the plan of the surface acoustic element concerning the configuration III of this invention.
[Drawing 6] It is the representative circuit schematic of a ladder mold surface acoustic wave filter.
[Drawing 7] It is the graph which shows the outline of the impedance characteristic of the surface acoustic wave resonator which constitutes a ladder mold surface acoustic wave filter.
[Drawing 8] It is the plan showing the connection of an external connection pad and a resistor.
[Drawing 9] It is the plan showing the connection of an external connection pad and a resistor.
[Drawing 10] It is the plan showing the connection of an external connection pad and a resistor.
[Drawing 11] It is the plan showing the connection of an external connection pad and a resistor.
[Description of Notations]
1 Piezo-electric Substrate
2A, 2B, 2C, 2D, 2E Surface acoustic wave resonator
21 22 Resonator connection pattern
3, 3A, 3B, 3D, 3E External connection pad
31 1st Metal Layer
32 2nd Metal Layer
33 3rd Metal Layer
4 Resistor
41 Resistor Bar
42 Metal Frame
5 Metallic-Oxide Layer

[Translation done.]